North Central Region Canola Research Grant
Progress Report
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Title

Effect of Tillage System and Nitrogen Source and Fertility on Canola Performance in Central North Dakota.

Investigators

Ezra Aberle, PI
Blaine Schatz, Co-PI

Abstract

This experiment examined the effects of tillage system, nitrogen (N) fertility, and soybean as the previous crop on canola performance. Utilizing 50 lbs of N in the form of manure as a fertilizer source achieved the same yields as applying 100 lbs of N as synthetic fertilizer. This reduced fertilizer costs by $31 per acre. Tillage system did not impact canola yield, so reducing tillage is an economically viable way to decrease canola input costs by $8 to 15 per acre. Soybean is an acceptable previous crop for canola production based on equivalent production achieved in trials with wheat as the previous crop. The trial results may be used to begin the generation of interest in expanding canola acreage in parts of North Dakota where soybean acreage is predominant. Additionally, the trial begins to build a database on using a widely planted legume as a strategy to reduce input costs for canola production.

Objective

To determine the effect of tillage system, N fertility and soybean as the previous crop on canola establishment, yield and quality, disease incidence and severity, and weed management.

Progress

Methods: The trial was conducted at the Carrington Research Extension Center in 2009. The experimental design for the trial was a split-split-plot design block design with three replicates. Hybrid canola seed was planted on May 8 at 500,000 seeds/acre. The trial was harvested August 26 and subsequently analyzed for yield and quality parameters.

Results: The 2009 growing season started out with great moisture but was cool with below average precipitation for the entire growing season and below normal temperatures for all months except August. The season averaged 4.4 degrees cooler than normal and was 5 inches below normal in precipitation by the end of August. Canola stands established in this trial were reduced in association with pushing the planting date relative to the very wet soil conditions this spring. Canola yields ranged from 447 to 1300 lbs/acre (Table 3). The high yield treatment in this trial correlates well with similar cultivars in the 2009 CREC's canola variety test. Total above ground biomass ranged for 2,387 to 5,285 lbs/acre (Table 3).

When we look at the impact of tillage system averaged across all fertility levels, we see that plant stand increases as the amount of tillage increases from No Till (N) to minimum tillage

(M) to conventional tillage (T) (Table 1). However, we also see in this study that flower duration and date of physiological maturity (PM) was longer and later for the No till system verses the tilled systems (Table 1). By flowering for a longer period there is an increased chance for greater seed set and by reaching PM later there is a potential chance for greater seed fill.

When we look at N fertility across all tillage systems, the zero N plots (0) had significantly lower biomass, grain, and straw yields than the additional levels of N (Table 2). We also see that the manure (M) treatment is statistically equal to the 100 lbs treatment for most parameters. The manure treatment also has a significantly higher Oil content and has an earlier PM date (Table 2).

The yields that were achieved this season did not have a favorable impact on the economic analysis of tillage system (Table 4) or fertility treatment (Table 5). However, the manure treatment did come close to breaking even (Table 5). The individual combination of manure as the fertilizer source and the minimum tillage system did generate a small profit (Table 6).

Impact

This research identified that manure is a favorable alternative fertilizer source for canola production that may reduce fertilizer cost. In this environment, tillage system did not impact canola yield so reducing tillage reduced input costs. Soybean as the previous crop did not adversely affect canola production based on yields achieved with this hybrid in trials with wheat as the previous crop. These research findings provide a baseline of information to suggest that opportunities exist to expand canola acreage in North Dakota where soybean is the previous crop.

Conclusions

Utilizing 50 lbs of N in the form of manure as a fertilizer source achieved the same yields as applying 100 lbs of N as synthetic fertilizer. This reduced fertilizer costs by $31 per acre. Tillage system did not impact canola yield so reducing tillage is an economically viable way to decrease canola input costs by $8 to 15 per acre. Soybean is an acceptable previous crop for canola production based on equivalent production achieved in trials with wheat as the previous crop. Further research is required across other growing seasons to appropriately assess the opportunity that soybean may present in reducing the input costs related to canola production.

Table 1. Tillage

	Biomass Weight	Straw Weight	Grain Yield	1000 KWT	Oil	Stand	Plant Ht.	Emergence	Bbloom	Ebloom	Bloom Duration	PM
		lbs/ acre		g	%	plants/acre	cm		Julian day		Days	Julian day
M	4,318	3,403	915	2.1	45.5	390,568	115	146	178	197	19.3	217.8
N	3,582	2,685	897	2.1	48.0	315,331	106	146	178	200	21.7	218.9
T	3,821	2,859	962	2.0	44.9	424,867	120	147	178	197	18.9	217.4
Mean	3,907	2,982	925	2.0	46.1	376,922	114	146	178	198	20.0	218.0
C.V.	23	30	21	11.5	16.2	19	7	0	1	0.4	6.7	0.4
LSD 0.05	NS	NS	NS	NS	NS	59,470	6	0	NS	1	1.1	1.1

Table 2. Fertility

	Biomass Weight	Straw Weight	Grain Yield	1000 KWT	Oil	Stand	Plant Ht.	Emergence	Bbloom	Ebloom	Bloom Duration	PM
		lbs/ acre		g	%	plants/acre	cm		Julian day		Days	Julian day
0	2,628	2,148	480	2.1	48.6	359,956	108	146	178	197	19.1	217.6
50	4,324	3,414	910	2.0	42.2	393,887	107	146	179	198	18.4	218.0
100	4,313	3,158	1,155	1.9	41.5	384,298	118	146	179	200	21.2	219.2
M	4,362	3,208	1,154	2.1	52.1	369,546	122	146	177	198	21.1	217.3
Mean	3,907	2,982	925	2.0	46.1	376,922	114	146	178	198	20.0	218.0
C.V.	23	30	21	11.5	16.2	19	7	0	1	0.4	6.7	0.4
LSD 0.05	891	873	188	NS	7.3	NS	7	NS	1	1	1.3	0.9

Table 3. Tillage by Fertility

		Biomass Weight	Straw Weight	Grain Yield	1000 KWT	Oil	Stand	Plant Ht.	Emergence	Bbloom	Ebloom	Bloom Duration	PM
			lbs/ acre		g	%	plants/acre	cm		Julian day		Days	Julian day
N	0	2,517	2,041	476	2.2	51.2	309,799	98	146	179	199	20.0	218.0
N	50	4,310	3,274	1,036	2.1	47.4	336,353	97	146	179	200	20.7	219.3
N	100	3,922	2,891	1,031	1.9	41.1	351,843	115	146	178	201	23.0	220.3
N	M	3,581	2,535	1,047	2.1	52.2	263,329	115	146	177	200	23.0	218.0
M	0	2,981	2,534	447	2.3	49.9	312,011	112	146	177	196	19.3	217.7
M	50	4,603	3,705	898	1.8	37.4	440,357	112	146	180	196	16.7	217.7
M	100	4,401	3,268	1,133	2.0	42.8	380,610	119	146	179	200	20.7	218.7
M	M	5,285	4,104	1,182	2.2	51.8	429,293	117	146	176	197	20.7	217.0
T	0	2,387	1,870	517	1.9	44.7	458,059	114	147	178	196	18.0	217.0
T	50	4,060	3,264	796	2.0	41.6	404,951	113	147	178	196	18.0	217.0
T	100	4,617	3,316	1,300	1.8	40.7	420,441	120	147	180	200	20.0	218.7
T	M	4,219	2,985	1,235	2.1	52.4	416,015	135	147	176	196	19.7	217.0
Mean		3,907	2,982	925	2.0	46.1	376,922	114	146	178	198	20.0	218.0
C.V.		23	30	21	11.5	16.2	19	7	0	1	0	6.7	0.4
LSD 0.05		NS	NS	NS	NS	NS	NS	NS	NS	2	1	NS	NS

Tillage System	Production Costs $/A				Yield lbs/A	Gross*** $/A	Net $/A
	Tillage	Seeding	Chemical	Total **			
N	$0.00	$15.00	$26.00	$204.64	897	$181.23	($63.77)
M	$8.01	$12.83	$21.00	$205.48	915	$143.93	($61.82)
T	$14.56	$12.83	$21.00	$212.03	962	$149.65	($61.04)

* Urea at $0.36/lb and Manure at $0.10/lb of N

** Includes: Fertilizer ($19.67avg), Seed ($28.50), Tillage, Seeding, Chemical, Swathing ($7.92), Combining ($20.55), Overhead ($32), Land ($55)

***Grain price $15.70/cwt

Fertility Treatment	Cost of Production $/A		Yield lbs/A	Gross*** $/A	Net $/A
	Fertilizer*	Total **			
0	$0.00	$185.07	480	$123.66	($109.74)
50	$18.00	$203.07	910	$136.49	($21.80)
100	$36.00	$221.07	1,155	$175.56	($78.22)
M	$5.00	$190.07	1,154	$197.37	($8.84)

* Urea at $0.36/lb and Manure at $0.10/lb of N

** Includes: Fertilizer ($19.67avg), Seed ($28.50), Tillage, Seeding ($13.55 avg), Chemical, Swathing ($7.92), Combining ($20.55), Overhead ($32), Land ($55)

***Grain price $15.70/cwt

Tillage System	Fertility Treatment	Production Costs					Yield lbs/A	Gross*** $/A	Net $/A
		Fertilizer*	Tillage	Seeding $/A	Chemical	Total **			
N	0	$0.00	$8.01	$12.83	$21.00	$185.81	476	$99.33	($111.13)
N	50	$18.00	$8.01	$12.83	$21.00	$203.81	1,036	$135.91	($41.21)
N	100	$36.00	$8.01	$15.00	$26.00	$228.98	1,031	$166.89	($67.11)
N	M	$5.00	$8.01	$12.83	$21.00	$190.81	1,047	$173.59	($26.48)
M	0	$0.00	$0.00	$12.83	$21.00	$177.80	447	$161.61	($107.62)
M	50	$18.00	$0.00	$15.00	$26.00	$202.97	898	$146.38	($61.93)
M	100	$36.00	$0.00	$12.83	$21.00	$213.80	1,133	$179.77	($35.92)
M	M	$5.00	$0.00	$12.83	$21.00	$182.80	1,182	$237.17	$2.72
T	0	$0.00	$14.56	$15.00	$26.00	$199.53	517	$110.06	($118.41)
T	50	$18.00	$14.56	$12.83	$21.00	$210.36	796	$127.17	($85.44)
T	100	$36.00	$14.56	$12.83	$21.00	$228.36	1,300	$180.03	($24.31)
T	M	$5.00	$14.56	$15.00	$26.00	$204.53	1,235	$181.34	($10.69)

* Urea at $0.36/lb and Manure at $0.10/lb of N

** Includes: Fertilizer, Seed ($28.50), Tillage, Seeding ($13.55 avg), Chemical, Swathing ($7.92), Combining ($20.55), Overhead ($32), Land ($55)

***Grain price $15.70/cwt